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A Discriminative Study of the Design and Construction of Outdoor Athletic and Physical Education Area Facilities for a Junior High School

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A DISCRIMINATIVE STUDY OF THE DESIGN AND CONSTRUCTION OF OUTDOOR ATHLETIC AND PHYSICAL EDUCATION AREA FACILITIES FOR A JUNIOR HIGH SCHOOL

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CHAPTER I

THE PROBLEM AND METHODS OF RESEARCH

When the attempt was first made to find information on the design and construction of outdoor athletic and physical education area facilities for a junior high school, it was discovered that there was very little written on the subject that could be used directly. What information was available was confined to a far more narrow subject than would be of use by itself. For example, much has been written about grass and turf, but very little can be found about grass when it is subjected to the rigors of athletic or playfield use. It seemed apparent, therefore, that it would not only be necessary to derive information from many and varied sources, but that conclusions would have to be drawn as a result of a gathering and interpretation of disassociated ideas.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study: (1) to determine what should be included in an ideal junior high school outdoor physical education and athletic area; (2) to learn the necessary general details of construction and design of those areas; and (3) to equip the writer with the necessary knowledge for him to actively

advise the construction of his own school's physical education and athletic area to the end that the area would provide for a complete program in years to come as well as to satisfy immediate needs.

Importance of the study. This country is in an era of rapid expansion of the buildings and facilities of education. In the rush of preparing these facilities for immediate use we sometimes lose sight of the long range viewpoint. This can result in the construction of poorly planned areas which soon prove to be inadequate and often provide an abundance of unnecessary maintenance problems. The writer contends that such a situation can best be prevented if the individuals who will be using the proposed facilities would prepare a thorough account of their needs and how they feel those needs can best be fulfilled in construction. Administrators and schoolmen usually agree that knowledge of this type is necessary before construction begins, but the writer's experience and observation have shown that in practice teachers who use the facilities are seldom consulted.

Limitations of the study. In the search for answers the author quickly realized that much of the material that was available could be thoroughly understood only by the engineer, geologist, or architect for whom it was intended.

As a result, this study has been confined generally to those areas that the lay schoolman can understand. It is further limited to those components of field study that apply to the particular situation and which are confined by such elements as school program and curriculum, climate, and physical potential of the area. It is the specific object of this paper, then, to prepare the writer and other teachers to intelligently advise the construction of a functional outdoor athletic and physical education area for a junior high school.

Organization of the material. The material presented in this study is divided in the following manner: (1) recommended junior high school outdoor activities and their material and area needs; (2) design considerations; (3) specific problems for construction consideration; and (4) construction features of individual area coverings.

II. METHODS OF RESEARCH

The initial research in this project was, of necessity, chiefly an informal one for it involved the determination of the needs for the outdoor athletic and activity area. These needs were based upon the program of the school, both curricular and extracurricular, and had to be projected to future phases of those programs as well as

the present requirements. These needs were ultimately determined by a combination of personal experience, discussion with others who worked in the field, and consultation with authoritative references.

This research is based on: (1) a study of the literature available on the subject; (2) interviews with authorities on individual phases of the study; and (3) a review and compilation of the material gathered so that it could be put into practical use.

CHAPTER II

RECOMMENDED JUNIOR HIGH SCHOOL OUTDOOR ACTIVITIES AND THEIR AREA NEEDS

The matter of what specific activities to include in planning, when considering the design and construction of outdoor athletic and physical education area facilities for a junior high school, seems to reflect the needs and problems of a given area and is dependent to a large degree upon individual thought and experience.

When planning any new facilities, basic educational and specific school objectives should be considered. It would be desirable if teachers, parents, school board members and students might be apprised of the relationship between facilities and attainment of educational objectives. Choice of activities for which space is to be allotted should depend upon whether or not the activity fits in with the program objectives. Local areas can, of course, receive guidance in selecting activities from contemporary leaders in the field. Additionally, there is rather wide spread agreement on activities that fulfill many of the needs of the junior high school age group. The activities recommended here are based upon the suggestions of one of the country's leading authorities on physical

education curriculum,[1] and revised to fit the local needs of the Puget Sound area of Western Washington.

I. COURT TYPE ACTIVITIES

Volleyball. The game of volleyball may be played on a variety of surfaces, but it appears that for most practical purposes a hard court is the best. One of the biggest advantages of the hard court is that it may be used as a multi-purpose area and combine with many other court games that may be played on the same surface. This is a matter that will be explored to a greater degree in Chapter III. The volleyball court is thirty feet wide by sixty feet long and must have at least a ten-foot clearance between courts and at the end of the court. Some arrangement must be made for the placement and holding of net standards along the middle of the length of the court. Several other volleyball type games such as newcomb and captainball may be played on the same area.

Basketball. The game of basketball must be played on a surface firm enough to give a strong and uniform return to the bounce of a basketball. The area recommended for a single court is ninety feet by fifty feet. Fifteen

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[1]Leslie W. Irwin, The Curriculum in Health and Physical Education (St. Louis: The C. V. Mosby Company, 1951), pp. 125-51.

feet should be allowed at each end of the court for maximum safety during fast play. However, since outdoor courts are seldom, if ever, used for actual scheduled competition in the game, it appears wise to limit the size of the court when doing so will allow for a larger number of courts in the same area. One standard basketball backboard and hoop is needed at each end of all basketball courts. These backboards should be mounted so that they extend several feet out from the standards to which they are fastened. As an additional safety factor, padding should be placed around the standards. Although the backboards are located so that they will provide the least possible interference with other games, the standards should still be mounted in an insert sleeve for easy removal.

Tennis. Tennis can be played on a variety of surfaces such as grass, clay, asphalt, cement, etc. The only basic requirement would seem to be that the surface is firm and even so that it will give a smooth uniform bounce to the ball. For school use the possibilities must be narrowed down to those which can hold up under a maximum of wear with a minimum of maintenance. Cement or some type of asphaltic surface is the only material that can adequately meet these latter requirements. The specific properties of surfaces will be taken up in a later chapter. A standard tennis

court is thirty-six feet by seventy-eight feet in size and requires a total area of fifty-five feet by one hundred and twenty feet. The latter area includes the necessary room for play space outside the boundaries which is a practical requirement in a game such as tennis. Heavy steel net standards must be provided since the tennis net is subject to considerable strain because of the close tolerance necessary in the uniform height of the net. The total weight must be born by the standards with no help from supplementary supports. A twelve-foot fence is a necessity at the ends of tennis courts and is recommended for all sides. The fencing must be twenty-one feet from the base line and ten feet beyond sidelines.[2]

Badminton, Paddle Tennis, and Deck Tennis. The surface requirements of these three activities are the same as for tennis. The reason the three are grouped together is that one area lay-out and one set of court lines will suffice for all three. The necessary court size is twenty feet by forty-four feet. This will require a total area per court of thirty feet by sixty-four feet.

Handball. The surface of a handball court must be

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[2]Athletic Institute, A Guide for Planning Facilities for Athletics, Recreation, Physical and Health Education (Chicago: The Athletic Institute, Inc., 1947), pp. 29-32.

hard and must provide a uniform bounce of the ball. This requirement is generally best filled by concrete or an asphaltic mixture. The asphalt seems to have the edge here because, as will be described in a later chapter, there are certain asphaltic combinations which have a greater degree of resilience than does concrete. A single wall court surface is thirty-four feet long and twenty feet wide which will require a total court area of forty-four by forty feet. A wall the length of the court and sixteen feet high is a requirement for handball play. A wall of concrete is suggested because of its uniform rebound, lasting quality and minimum of maintenance. Although a wall of this type is comparatively costly from the original investment standpoint, the usability of the facility for other sports should be taken into consideration along with the ease of maintenance. This is particularly true of tennis and the tennis type games.[3]

Horseshoes and Quoits. The principal deciding point in determination of the size of a horseshoe court is the distance between the stakes. This distance varies from twenty-five feet for children to forty feet for men and

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[3]N. L. Engelhardt and N. L. Engelhardt, Jr., Planning the Community School (San Francisco: American Book Company, 1940), pp. 121-32.

older boys. It is recommended that a total area size for each court of twenty feet by seventy-four feet be allowed.[4] The only special surface or construction needed is a pit of sand, surrounding the stake, for the horseshoe to land in.

II. FIELD TYPE ACTIVITIES

Football, Soccer, Speedball, and Field Hockey. These four activities have almost identical area needs with the only basic difference being a slight variation in size. The official size can be easily compromised, however, when dealing with physical education play. The most feasible compromise would be to use the size of the official football field as a multi-purpose area for these activities. The football field is three hundred sixty feet long, including end zones, and one hundred sixty feet wide.[5] However, for an activity area it would seem wise to reduce this to a three hundred foot length and if space conditions warrant it, a one hundred fifty foot width. The field markings will vary with the purpose for which the field is used at a given time, but that has little relation to the area needs of the sport and can be adjusted to in the sport season. The goals or goal posts are also different for the

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[4] Ibid., p. 130.

[5] Ibid.

various activities, but this problem can be met by the use of a multi-purpose sleeve in the ground which will be discussed in Chapter IV. Other matters which relate to all types of field activities as well as to football type games, such as drainage, grass, and waterings, will also be taken up in Chapter IV.

Softball. One of the chief advantages of the game of softball is that it is flexible enough to be used as an effective activity regardless of the age, size, and ability of the participants. This flexibility is attained partly because it is possible to vary the distance between bases and the distance from home plate to the pitcher's box. The standard distance between bases is sixty feet and room should be allowed for this maximum. Then in the event of use by elementary school children or by girls, the bases may still be moved in as close as the official minimum which is a distance of forty-five feet between bases. The maximum outfield area necessary would be enclosed by a circular line whose ends start at points two hundred feet from home plate and in a line with first and third base, respectively.[6] In a junior high school situation it is usually reasonable to assume that such an abundance of

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[6] Ibid., p. 130.

outfield area will seldom be needed and that if the situation requires additional diamonds, it would be all right to overlap the two hundred foot outfields of diamonds that are facing in opposite or nearly opposite directions.

Baseball. The game of baseball is more exacting in its specifications than softball because of such things as the raised pitcher's mound, the skinned areas, and other associated areas.

Since the official diamond calls for ninety feet between bases, there should be no variation from it. The total area needed should measure two hundred fifty feet by two hundred fifty feet, with at least twenty feet of space free behind home plate and along the boundary lines to first and third bases. For details of the actual diamond lay-out as well as the skinned areas, see Figure 2.

III. SPECIAL TYPE ACTIVITIES

Calisthenics and Marching. Marching or drill, as an activity, can take place on either a turf field or on the hard court surface. The only requirement would seem to be that enough space be provided for the number involved in the activity. No special space or area need be planned for this activity.

Track and Field. The total surface area needed for a complete track and field lay-out would be seven hundred feet by four hundred feet. This would allow for a two hundred twenty yard straightaway and an oval track one-fourth mile long. The field events would be contained within the boundaries of the track. All running surfaces will be constructed of a built-up cinder type which will be discussed in Chapter V. The majority of the area surrounded by the track will be covered with turf and will also be used as a football exhibition area. There are times when conflict will prevail in the use of a given area for different activities. For example, some of the jumping pits will be too close to the football playing surface for maximum safety. Ways in which this situation can be compensated for will be suggested in the section on combination and multi-purpose areas in Chapter III.

Archery. An area for archery requires little in the way of built-in facilities. The basic requirement, outside of mere space, is that the area behind the targets be completely devoid of people or animals. In order that this might be possible, the area must have some sort of a backstop. A high sod bank is preferable, or possibly the blank wall of a brick or cement building. About the only other alternative would be to have a very remote area behind the

targets. The archery area itself should have one hundred fifty yards of length and at least thirty yards of width allowed.[7] The actual width would depend upon the number of individual ranges in use at a time.

Camping Education. The field of camping is one where education in the public schools is taking an ever increasing responsibility. The actual size of this area is largely dependent upon how extensive a given school's program in camping education is. At any rate, there is need for a wooded area, an arboretum, and possibly a garden.[8]

Amphitheater or Natural Theater. According to McFadzean, who has taken part in planning some of the outstanding athletic areas in the country, an amphitheater or council ring should occupy an important place in the planning of any high school or junior high. Such planning is dependent upon whether the weather would permit programs to be held in such an area during the fall, spring, or summer.[9] The stage for such an area should be located on

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[7] Ibid., p. 132.

[8] National Council on Schoolhouse Construction, Guide for Planning School Plants (Washington, D.C.: State Department of Education, 1946), p. 134.

[9] John McFadzean, "Site Planning: Reno High School," The Athletic Journal (June, 1950), pp. 26-32.

a plateau not less than thirty-five feet deep and fifty feet wide. The hillside leading down to the stage should be terraced and covered with a thick and well rooted turf. Seats are unnecessary since the audience may sit right on the turf.[10]

Now that the area needs for the different activities have been determined, the following chapter will deal with the design of those areas.

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[10]Engelhardt and Engelhardt, op. cit., p. 132.

CHAPTER III

CONSIDERATIONS OF DESIGN

There are many factors to be considered when attempting to determine where, in the total picture, each activity area should be. There is also the problem of individual area design. Planning for both of these must reflect thought in relation to the maximum possible use of all areas. This would include a consideration of existing features and problems of the area, as well as combination or multiple use of facilities. This chapter then will be devoted to these problems, as well as to area design.

I. CONSIDERATION OF EXISTING FEATURES

Terrain and natural landscape. When planning a facility or structure of any type, one should consider the existing landscape. For example, is there a natural slope available that could be converted into an amphitheater without a major excavation? This would require a rapid slope not less than thirty-five feet deep and would present a considerable problem if the entire project had to be undertaken from a flat area.[1]

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[1] N. L. Engelhardt and N. L. Engelhardt, Jr., Planning the Community School (San Francisco: American Book Company, 1940), p. 132.

Again depending upon the natural slope of the land, it must be determined whether to attempt to locate all the activity areas on one level or to terrace the total field into two or more levels. The one level is normally the most advantageous from the standpoint of multi-purpose facilities and the overlapping of certain other areas.

Too often the first step in preparing any athletic or activity area is to clear the entire area of all trees or bushes. Then when the field is ready to be landscaped it is discovered, too late, that much of the growth originally on the land would have been of use just where it had been. As a result, it behooves the planner to allow as many attractive trees and shrubs to remain on the land as might possibly be used in the ultimate completion of the area plan. This is particularly true when considering an arboretum or wooded area for camping education.

Sun direction. One of the responsibilities of area design is to give the maximum possible sun glare protection to the players. Williams and Brownell suggest that baseball diamonds and tennis courts should be laid out on a line approximately twenty degrees East of North by twenty degrees West of South.[2] It is not always possible to do

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[2]Jesse F. Williams and Clifford L. Brownell, The Administration of Health and Physical Education (Philadelphia: W. B. Saunders Company, 1934), pp. 387-8.

this, however, because of the physical condition of the area. Another suggestion is that the normal flight of the ball should intersect the early morning or late afternoon sun rays at a ninety degree angle. In activities like baseball, where the flight of the ball may be anywhere within a ninety degree radius, a line from second base to home plate should serve as the axis.[3]

In some localities a prevailing wind may be strong enough to affect the design directions, but generally the sun takes precedence in this matter.

II. COMBINATION AND MULTI-PURPOSE AREAS

Any functional athletic and activity area must make use of individual sections for several purposes depending upon the season and upon curricular and co-curricular requirements. It is the intent of this section to present some ideas which are designed to make the multiple use of facilities most practical. It must be considered, of course, that " . . . if a single area is to be used for more than one activity something of the ideal for each must be sacrificed, either from the standpoint of the players or spectators."[4] Regardless, it is still the opinion of

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[3]Athletic Institute, A Guide for Planning Facilities for Athletics, Recreation, Physical Education (Chicago: The Athletic Institute, Inc., 1947), pp. 31-2.

[4]"Your Stadium," Scholastic Coach, 17:7, January, 1948.

most authorities as well as of this writer, that multi-purpose areas are not only practical but very desirable for public school use.

Multi-purpose court areas. A great variety of games may be played at different times on any given flat, hard surface. The only limitations would be space requirements or the need of special facilities for any given court activity.

Lines are always a problem whether the surface to be used is inside or outside. One method of nearly eliminating confusion in this case is to use lines of strongly contrasting colors on the various activity court lay-outs. For example, the basketball lines might be red, the tennis lines black, and the paddle tennis lines green.

The use of certain special standards and equipment are another problem. Certain types of equipment, such as basketball backboards and standards, can be designed into the plan and placed so that they will not interfere with the playing of other activities on the area. Others, such as the posts which support the various nets for games like tennis and volleyball, present quite another problem. One solution to the problem is to insert the posts in pipes of a larger diameter about three feet long and sunk in the ground on the court area. The pipes are set in concrete

and their tops are threaded and provided with a cap, the top of which is flush with the court level. The caps are removed and the posts are set in the pipes and held firmly in place with metal wedges when the court is in use.[5]

Design or placement of activity areas plays a big part in the effectiveness of multiple use areas. It is necessary to consider the nature of the game in determining which might fit together best. One idea is to group all those activities which require, above all, a uniform rebound of a ball from the surface. These might include basketball and tennis. On the other hand, volleyball does not require any rebound qualities from the surface and could be played on a less regular surface. Further examples of multi-purpose design will be presented later in this chapter.

Multi-purpose field areas. The use of field areas for a variety of activities presents new problems. The surface used is now mostly turf and lines must be made with the realization that they are only temporary. To facilitate the repeated markings and switching from one type of activity to another, it is necessary to have some type of stable reference from which the lines can be made. For this

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[5]George D. Butler, Recreation Areas, Their Design and Equipment (New York: A. S. Barnes and Company, 1947), pp. 6-8.

purpose, short sections of pipe of small diameter may be inserted vertically in the ground at the corners or at points where lines intersect, with their tops set just below ground level. Such pipes may also be used for holding corner flags for such games as football.[6] Pipes of this type may also be used to mark starting and finishing points on a track. They could even be used to mark relay points and spots for hurdle placement.

There also is the problem of installation and removal of upright goal posts in the turf field. For this purpose, the goal posts can be set in concrete sleeves, so they may be removed as desired. The top is two inches below the ground level. This is capped and covered with dirt or turf when the goal posts are removed.[7]

As will be shown later in the chapter, the track and the exhibition football field are located in the same area. The running track will circle the football field. This means that the field events will take place directly beside the football field. To eliminate the danger to the football players in such a situation, all field event pits should be covered with removable platforms during the off season. The cover can then be turfed over.[8]

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[6] Ibid.

[7] Ibid.

[8] "Your Stadium," op. cit.

III. INDIVIDUAL AREA DESIGN

A very valuable aid in planning is a good set of individual area designs. Probably the most complete and most easily obtainable of the sources is the booklet published by Lowe and Campbell Athletic Goods.[9] The same company published a wall chart with the same diagrams which may prove to be more practical in many cases than the booklet.

There are some individual designs that are not readily available and that make a basic contribution to the total plan. These will be presented and discussed.

Track and football design. Of the many plans used to combine the seasonal activities of football and track and field into the same area, the design presented by Bresnahan and Tuttle appears to be the most practical.[10] The big problem in track and field lay-outs is that all the field events be placed so that they do not interfere with one another. That problem seems to be well taken care of in this plan. It also allows for construction of the

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[9] Athletic Field and Court Diagrams, A booklet of diagrams prepared by Lowe and Campbell Athletic Goods Company (Kansas City: Lowe and Campbell Athletic Goods, 1951).

[10] George T. Bresnahan and W. W. Tuttle, Track and Field Athletics (St. Louis: C. V. Mosby, 1950), pp. 466-7.

pits and runways for the field events to be outside the boundaries of the regulation football field. This feature will hold damage to the football turf by the field event traffic to a minimum and give the turf a rest during the off season. For a diagram of this plan see Figure 1.

Certain events, such as the discus throw and the javelin throw, which are included in this plan, probably would not be used on the junior high school level, but it is a good idea to allow for them. The junior high school would probably substitute other events in this area such as the football throw. There is also the possibility of other age groups using the field.

Baseball design. The matter of the actual area need of baseball has been covered in Chapter II. However, the specific measurements and design of a diamond in relation to what part of the area should be turf and what part should be skinned is another question. Most of the baseball playing area is covered with turf. The grass on the turf should be kept clipped short enough that it will not interfere with the uniform bounce of a hit ball.

Skinned, or dirt areas, include a nine-foot radius around the center point of the pitcher's mound, and a seven-foot wide lane connecting the pitcher's mound with the bare circle determined by a twenty-foot radius circle

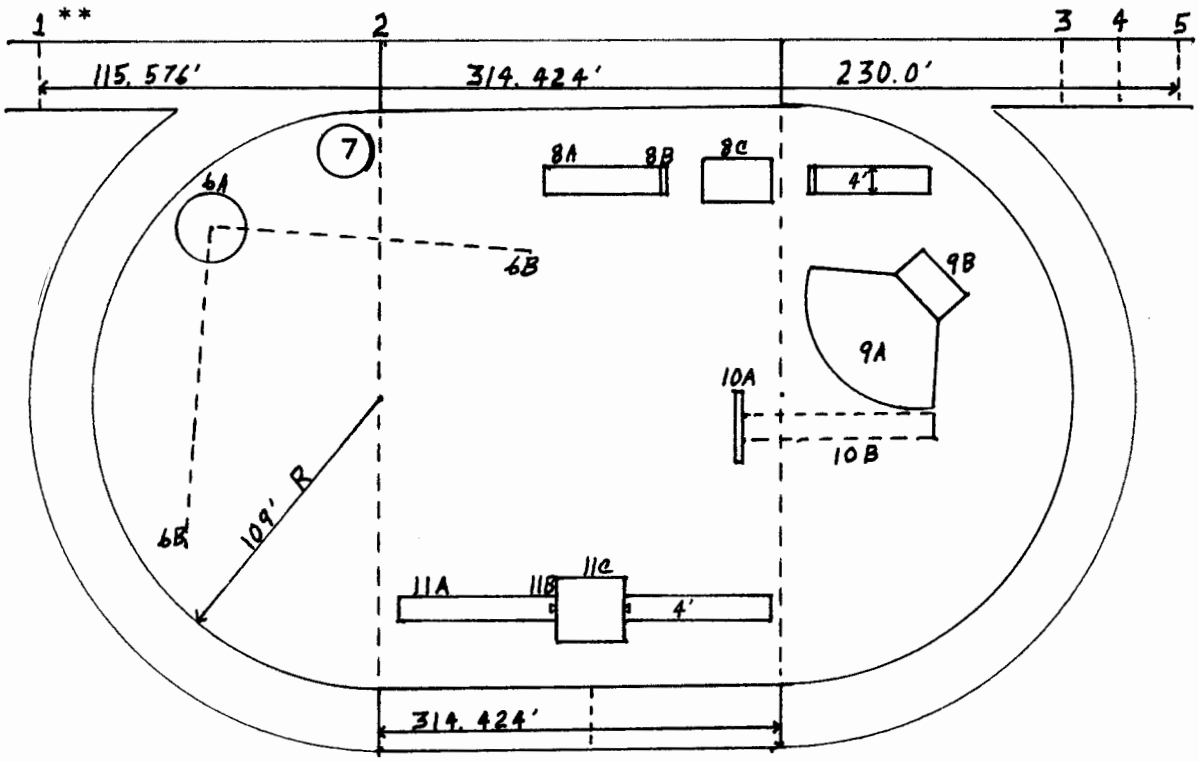

FIGURE 1

A BASIC TRACK AND FIELD LAY-OUT*

*It must be noted that the field event lay-out is not to scale. These events can be accommodated outside the boundaries of a regulation football field. The football field will, of course, be used as an area into which the discus and javelin will be thrown. The circle and runway for these two events shall be off the actual field.

**A key to the numbers on this design will be found on the following page.

KEY TO TRACK AND FIELD LAY-OUT

1. Finish of 220 yard events.
2. Start and finish of 440 yard, 880 yard, 1 mile, and 2 mile events; finish of 100 yard and 120 yard events.
3. Start of 100 yard events.
4. Start of 120 yard events.
5. Start of 220 yard events (straightaway).

6A. Discus circle.

6B. Discus sector (90 degrees) flags.

7. Shot circle.

8A. Running broad jump runways.

8B. Take-off boards for running broad jump.

8C. Pit for running broad jump.

9A. Running high jump approach.

9B. Pit for running high jump.

10A. Javelin scratch board.

10B. Javelin runway.

11A. Pole vault runways.

11B. Trough for planting pole.

12. 220 yard post.

around the center point of home plate. Skinned lanes should be included to a distance of three feet on both sides of the first and third base lines. Except for the above specifications, a turf square eighty-four feet across is located inside the four base paths. Excluding this turf area, the remainder of the infield, included in a radius of one hundred one feet, nine inches from the center of the pitcher's mound, shall be skinned. For a more graphic example of the exact specifications in this matter, see Figure 2.

Utilization of limited area in the design for three major sports. For the school that has a limited amount of space to devote to athletics, Figure 3 presents some interesting ideas. An area with this design has been built and used with enthusiastic success by the high school at Nyssa, Oregon, according to Superintendent of Schools Henry Hartley.[11] Although the track surrounds the baseball field, the danger of track athletes being hit by baseballs is minimized by the triangular shape of the track which generally parallels the first and third base lines of the ball diamond. Danger from rolling balls can be lessened by the raised curb on the inside of the track. The track

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[11]Henry Hartley, "The Nyssa Athletic Field," American School Board Journal (December, 1953), pp. 32-3.

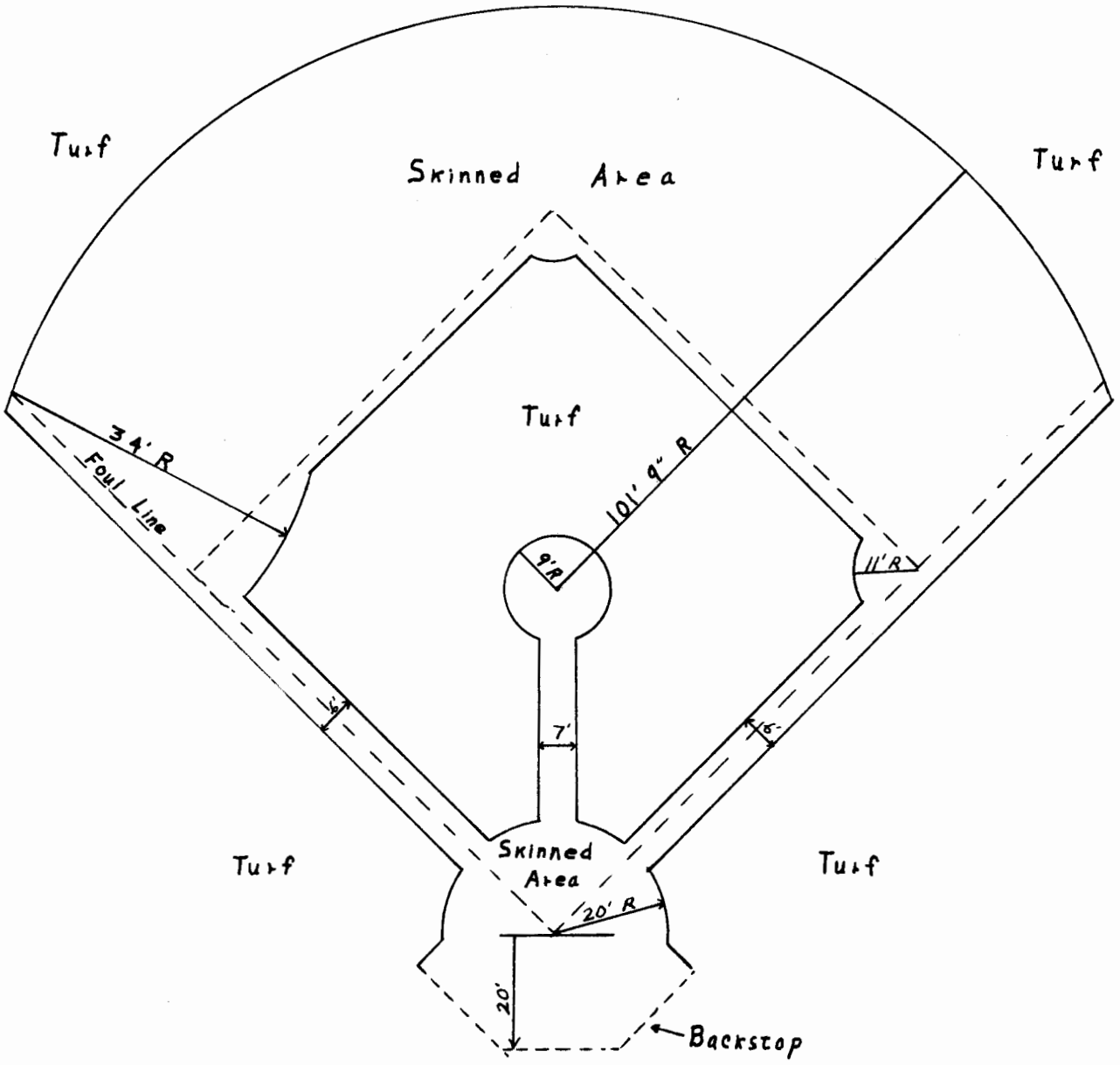

FIGURE 2

PLAN OF BASEBALL DIAMOND
SHOWING SKINNED AREA

is a standard one-fourth mile long and it includes a two hundred twenty yard straightaway for the sprint and hurdle races. The track, with its triangular shape, is the most revolutionary feature in the plan. Despite the fact that this creates sharper corners, Hartley claims that the times made on this track have been comparable with standard oval tracks in the same locality.[12] Field events are held between the football field and the track.

The fact that one lighting system can serve the area for three sports presents a large potential saving compared to the cost of a multiple installation. A further saving can be made by the use of portable seating.

Multi-purpose parking lot line design. The sense that the word parking lot is used is to denote an area that is used only during large attendance activities at the school, and since these activities occur mainly at night, the lot is available for other uses during the day. Some activities which can use this area to advantage are calisthenics, marching, a great variety of low organization games, volleyball, and other related court activities.

If a variety of activities are to be served, certain lines must be painted on the area surface. A series of

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[12] Ibid.

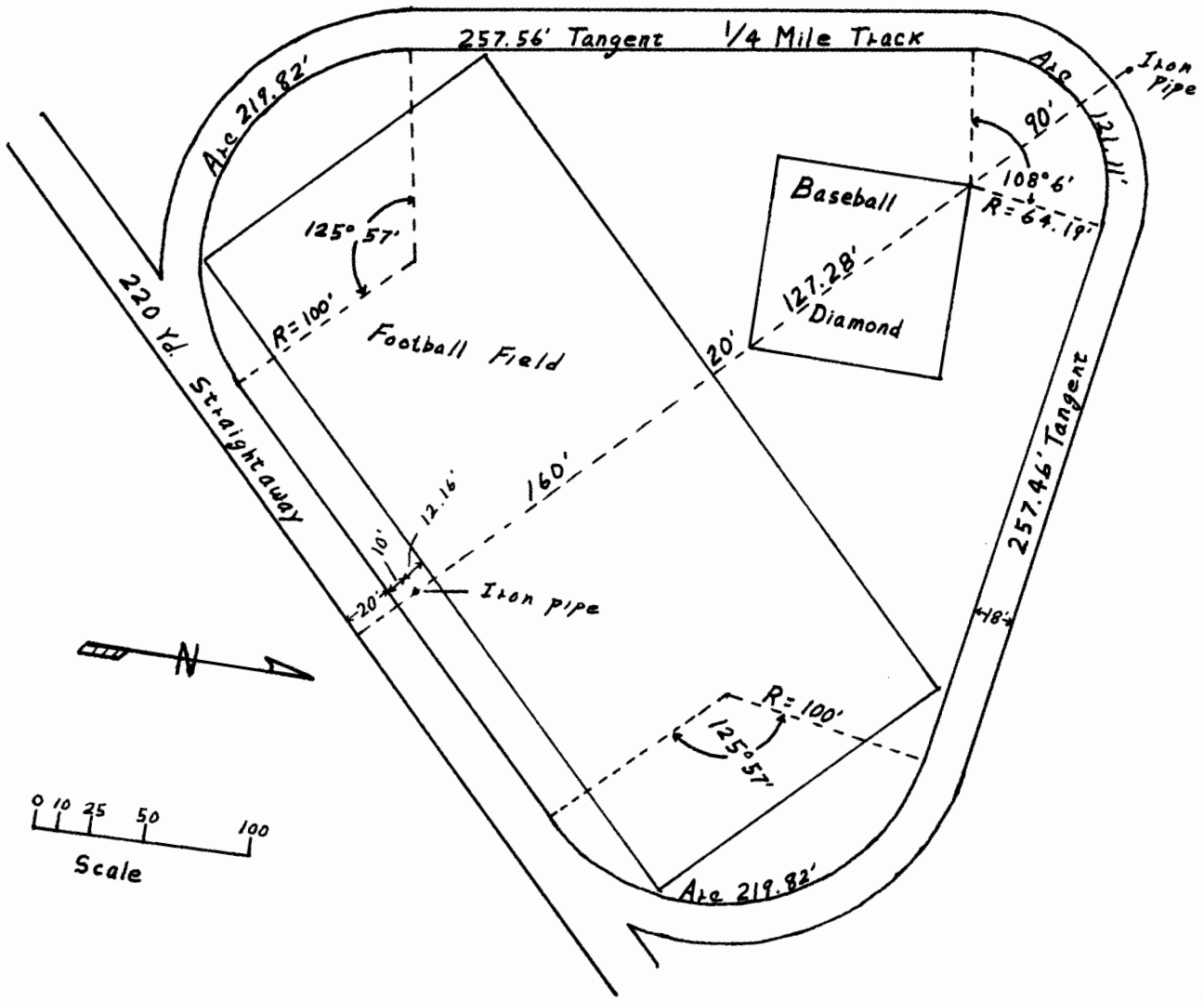

FIGURE 3

PLAN FOR RADICAL DESIGN OF
ATHLETIC FIELD

standard sized volleyball courts would be the first necessity for that game. The volleyball court is of an average size specification in respect to other court games and can sometimes be used for those games. In addition, the square and rectangular enclosed areas created by the volleyball court lines provide the necessary defined areas for many low organization games. The addition of a thirty-foot diameter circle in the center of each volleyball court would fill the need for the circular area required by many other low organization games. It is possible to line out a total of eight volleyball courts on a one hundred ten foot by two hundred foot parking lot and still leave adequate space on all sides of the activity areas to meet the action and safety requirements of the sports that will be played there. For the author's conception of how such an area should be designed, see Figure 4.

Hard surface multiple use court area. Because of the expense of installation and of the space consumed by an extensive court area, it is necessary and desirable to use that facility for as many activities as possible. One of the methods of facilitating this multiple use is through the operation of a system of removable posts and net standards. This matter has been discussed in Chapter II.

In arranging the various courts to be used in a

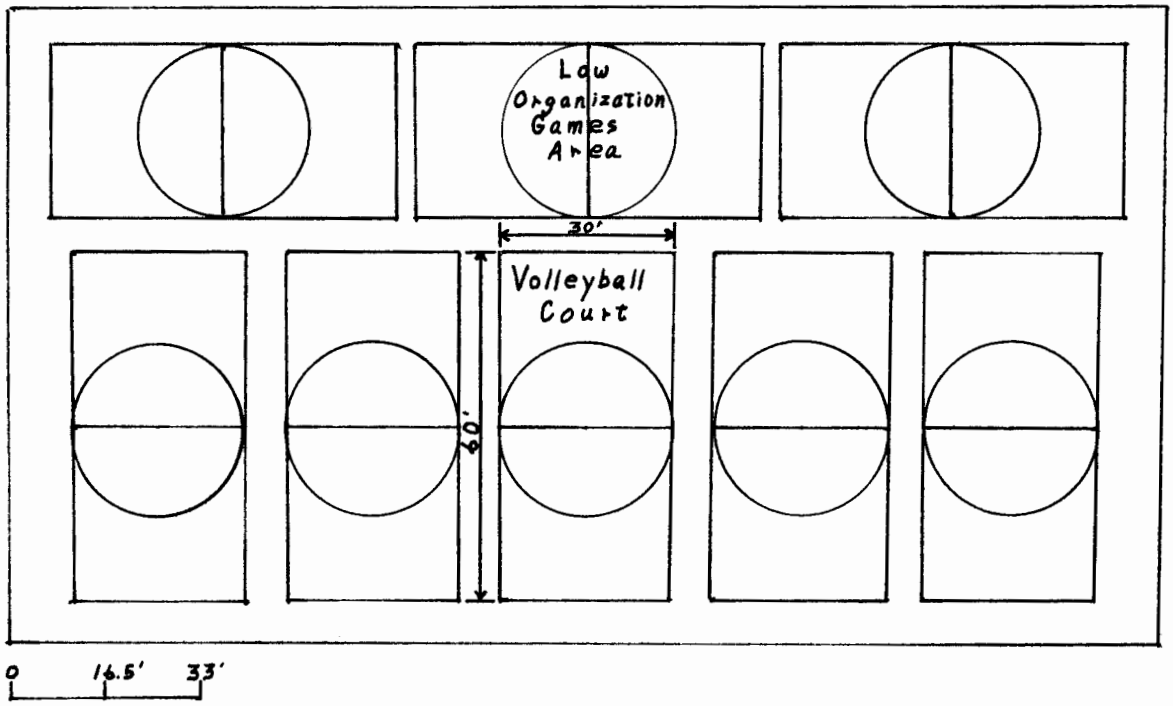

FIGURE 4

MULTI-PURPOSE PARKING LOT LINE DESIGN

given area, a plan must avoid confusion as much as possible by limiting the number of lines used, keeping all lines parallel to one of the two sets of area sidelines, and using a court line color code simple enough to be easily understood. To facilitate use of such an area it will be necessary to thoroughly orient the people who are using the courts and to keep an explanation of the color code and marking system prominently posted. Safety measures, in respect to adequate area for each court, are carefully observed in this design.

For the author's conception of how a multiple use court area would be designed, see Figure 5. It will be noted that the paddle tennis courts and the basketball courts run in one direction, while the tennis courts run the opposite way. It is ordinarily desirable to have the long axis of the larger number of courts running in an approximately North-South direction. While there are a fairly large number of lines used, the use of three strongly constrasting colors for the three types of courts help define those areas.

The lack of physical obstructions and the relatively compact nature of this design aid in the effective supervision of the individual activities accounted for.

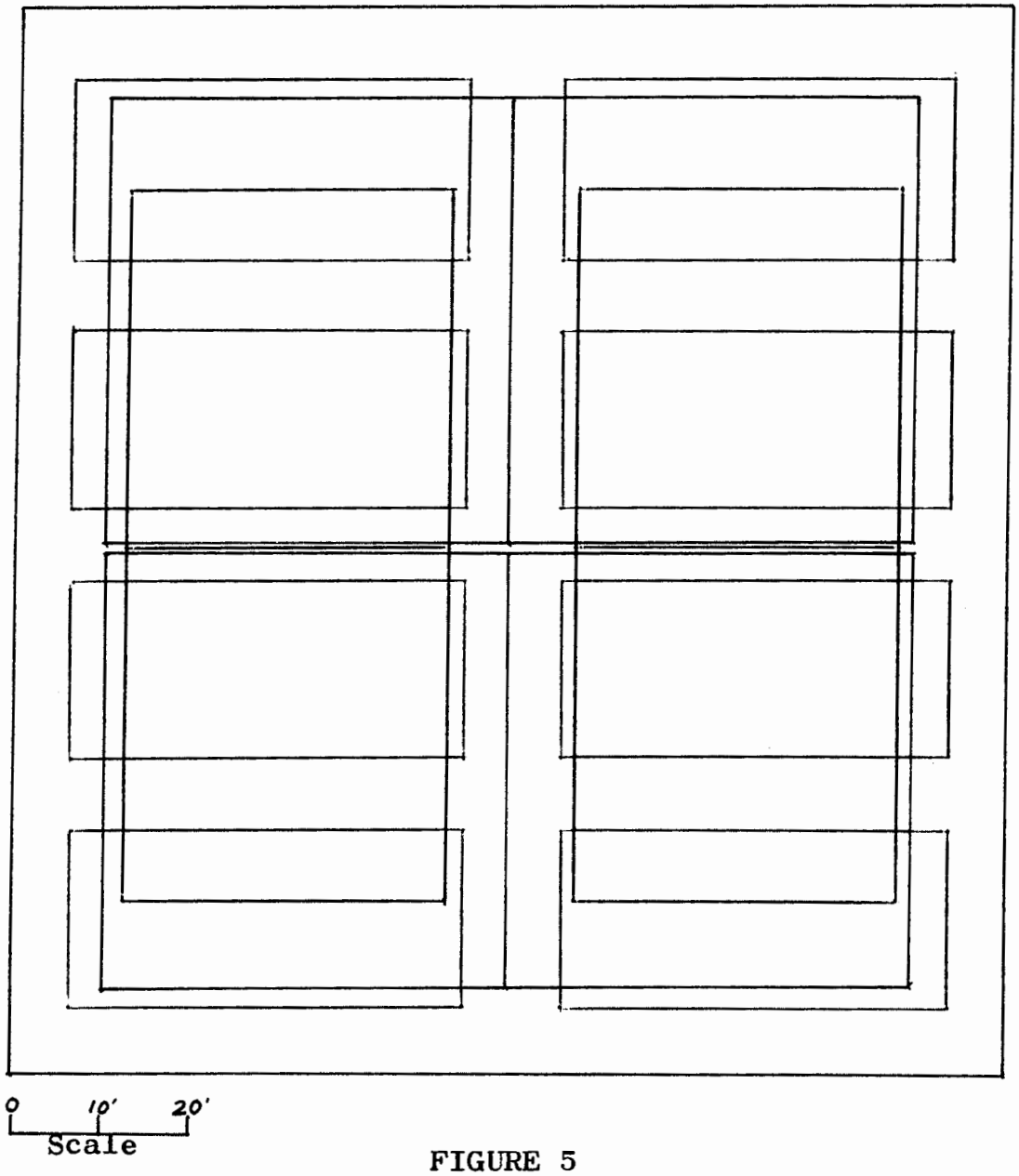

FIGURE 5

DESIGN FOR HARD SURFACE MULTIPLE USE COURT AREA

Color Code

____ Basketball; ____ Tennis; ____ Paddle Tennis.

IV. TOTAL AREA DESIGN

The total area design presented here is a suggestion by which the general design ideas which have been made up to this point may be carried out. It must be kept in mind that no design of this type can be completely applicable to any area other than the one for which it was made. The reason for this is obvious since no two sites are exactly the same. Of course, there is much in the plan which can be transposed to other situations and adapted to specific requirements of the site.

Relationship of the location of activities to that of the school. One of the major factors to keep in mind when locating the areas to be used by different activities is their comparative amount of use. Thus, it is better to put those activities which are more heavily used as close to the school and dressing rooms as possible. The varsity activity areas will be used by the least number of students and should occupy the most remote of the available areas.

Orientation of the turf activity areas. Since the activities which will take place on the turf areas are an important part of the daily physical education program, it is logical that they should be designed as close to the school as possible. All softball and baseball diamonds

are located so that the pitcher and catcher always receive a maximum degree of protection from the direct sun. The total area shown in the design of each softball area represents the maximum safety requirements for that activity on the junior high level. A buffer zone is allowed between the sidelines of the activity fields as a safety measure and as room for substitutes and officials. The fact that all the field activities are designed into a single unobstructed area allows an effective degree of teacher supervision. The deciding factor in the orientation of the activity fields was the way in which the area available could be put to the most use. Sun direction has little effect upon the type of activities that take place on such fields, but it seems desirable to have the sun pass over the width of the field when a choice is available. Since the infield of the baseball diamond will be skinned of turf, no other activity will be designed into that area.

Orientation of the track and football field. The long axis of the track and football field should run in a generally East-West direction. Although this orientation sometimes causes one of the football teams to look almost directly into the sun, such a location is common practice in this State. It is felt that any disadvantage, in respect to sun location, is made up within the rules of the

game. Spectator seating is provided for on the north side of the field and directly in front of the finish line for most of the running events in track.

Orientation of the court areas. It is recommended that whenever possible, court areas should be located with their long axis in a North-South direction. The multi-purpose courts, as designed in Figure 5, have two courts running in one direction and one in the other. It is only logical, then, that the area should be placed so that the sun advantage is given to the larger number of game courts.

The handball courts are located next to the horseshoe pits so that they can both be utilized at the same time in the case of large physical education classes. The pits are located so that horseshoe participants will not have to look into the sun while throwing. The area is also confined by the two court areas in such a way as to minimize the possibility of anyone wandering into the throwing area.

The parking lot and paved activity area combination is centrally located. Placed here, it can be used for a parking lot in connection with the varsity exhibition area, the school buildings, or any of the other activity areas.

Special activity areas. The amphitheater is placed so that it can be easily reached from either the parking lot or the school. It is oriented so that the sun will be

at the spectators' backs during the afternoon.

Because of the nature of the areas, it is necessary that both the outdoor theater and the camping area be as close to the school buildings as possible. The camping area need not be confined to a specific location, but it is valuable to have such an area complete with the tools and elements necessary to teach those fundamentals of outdoor education with which the particular school intends to deal.

For the author's conception of how such a properly oriented total area design should look, see Figure 6.

This chapter has been concerned with considerations of physical education area design. It has dealt with existing features of the area, the use of multi-purpose areas, individual area design, and total area design. The following chapter will be devoted to consideration of major problems in athletic and activity field construction.

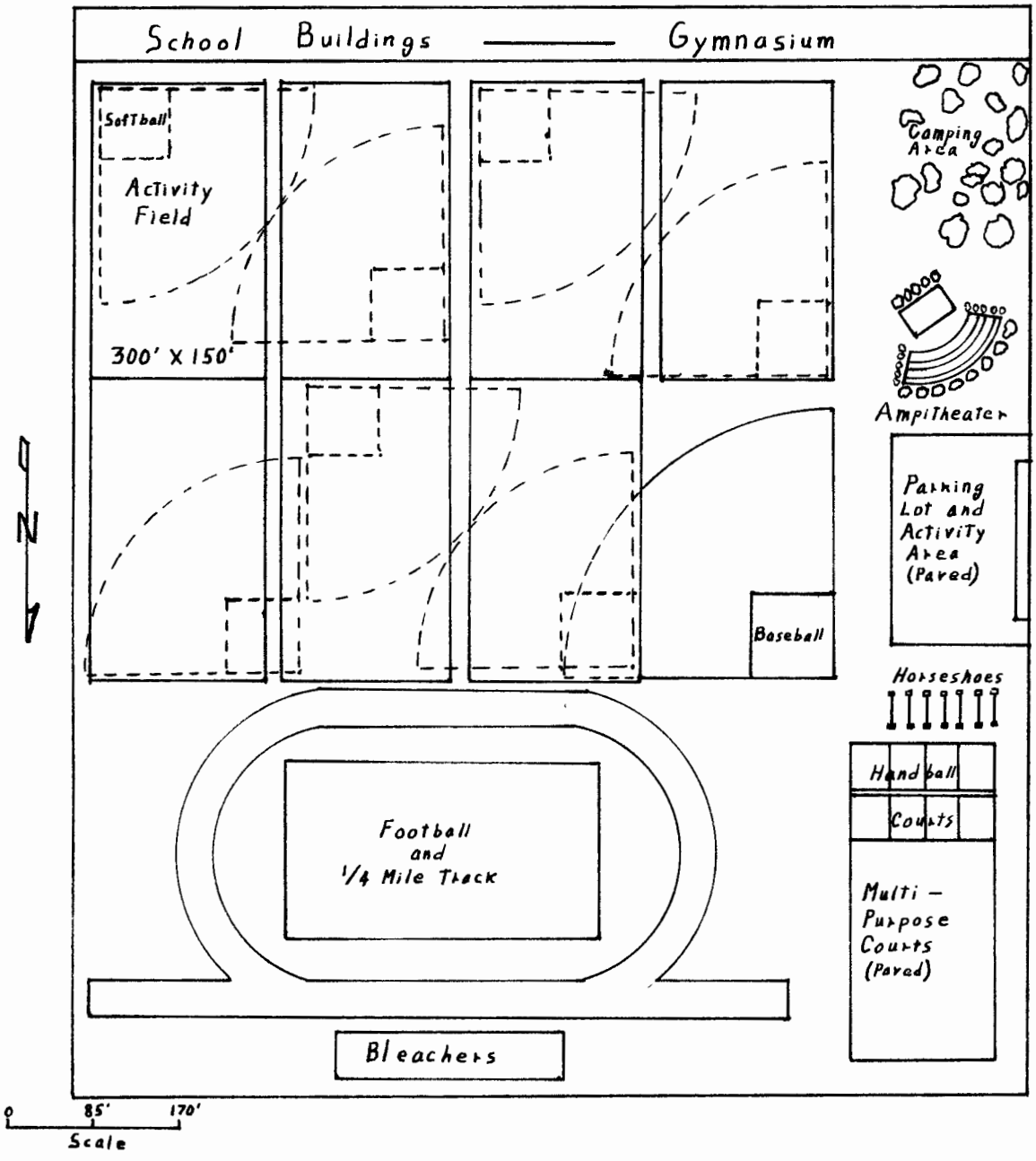

FIGURE 6

A WELL ORIENTED PHYSICAL EDUCATION FIELD DESIGN

_____ Basic Line Design _____ Overlay

CHAPTER IV

SPECIFIC PROBLEMS FOR CONSTRUCTION CONSIDERATION

There are major problems in athletic and activity field construction which are over and above the considerations of area design described. They are most important both individually and in their contribution to the total plan. Such things as field drainage, artificial lighting, fencing, backstops, and landscaping have been placed in this category.

I. DRAINAGE

Depending on the various local conditions prevailing in respect to soil structure and weather, the field will have to make use of one of two basic types of drainage systems. They shall be referred to as surface drainage and sub-soil drainage in this paper.

Surface Drainage

Surface drainage is controlled by grading. The greater the slope of the ground, the faster the runoff will be. One source states that the grade should drop six inches for every one hundred feet of the field.[1] However,

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[1]Jesse F. Williams and Clifford L. Brownell, The Administration of Health and Physical Education (Philadelphia: W. B. Saunders Company, 1934), pp. 387-95.

another authority claims that the slope should be twice that steep and drop one foot for every one hundred feet.[2] A more logical frame of reference would seem to be that which suggests that the slope be limited to between one per cent and three per cent. The authority in this case suggests that any slope less than one per cent is too flat, and any grade in excess of three per cent tends to cause erosion.[3]

If the project is to be built in a dry climate, the surface drainage system could be sufficient regardless of the soil structure. On the other hand, surface drainage could still be acceptable in a fairly damp climate providing the structure of the soil is sandy enough to permit easy drainage and rapid runoff of the rain. However, as is often the case in the Pacific Northwest, a predominantly clay or loam soil existing in a climate that is particularly damp during a good share of the year presents a situation that must be dealt with in another manner.

Sub-soil Drainage

Sub-soil drainage involves those preparations for drainage which are made below the surface. This may mean

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[2]George D. Butler, Recreation Areas, Their Design and Equipment (New York: A. S. Barnes and Company, 1947), p. 8.

[3]Athletic Institute, A Guide for Planning Facilities

only that the sub-soil is arranged or brought in to provide a porous foundation that will drain off the surface water by allowing it to pass right through. In many cases, however, this is not sufficient and a tile drainage system is required.

According to Beauchamp:

> Tile drainage removes excess water from the soil through a continuous line of tile laid at a specified depth and grade. Free water enters through the tile joints and flows out by gravity, so that the water table is lowered below the root zone of the plants.[4]

In a tile drainage system, lateral drains remove the free water from the soil. Submains collect the water from a group of laterals. A main carries the tile water from the submains and laterals to the outlet.[5] When tile drains are properly planned and installed, they become a permanent improvement that requires little or no maintenance. Although original cost may seem high at the time, it pays to install a system that will always prove adequate. In doing the research for this study, a case of one school was investigated by the writer where several thousand

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for Athletics, Recreation, Physical and Health Education (Chicago: The Athletic Institute, Inc., 1947), p. 28.

[4]The United States Department of Agriculture, Water The Yearbook of Agriculture 1955 (Washington, D.C.: The United States Government Printing Office, 1955), p. 508.

[5]Ibid.

dollars was spent over a three-year period in an unsuccessful attempt to provide drainage on a field for which no original drainage was provided. Now they are faced with the additional expense and inconvenience of installing a tile system when the field should be in use for summer recreation and fall sports.

When considering tile drainage systems in general, Butler reports that:

> Four-inch tile is considered the minimum for ground water drainage; six-inch tile for drainage from inlets and catch basins. The amount of drainage desirable under an area depends upon the type of soil and the water level. The deeper the tile drains are laid the slower the action, but the wider the area drained. In heavy soils the laterals are required at more frequent intervals than in lighter soils; they are generally laid approximately three feet in depth and at intervals of 15 feet or less in stiff clay. Agricultural tile or vitrified tile with open joints is most commonly used. Important considerations in laying tile are: making the excavation to the exact depth required, using an accurate grade line and straight drainage lines, providing space between ends of drain tile and avoiding too many main outlets. Drainage ditches are backfilled to within a few inches of the surface with coarse gravel, crushed rock or cinders. Usually the drainage lines for surface and ground water are combined.[6]

What Butler reports may apply to any drain tile but there are still various systems to consider. According to Beauchamp, writing in the 1955 Yearbook of Agriculture: "Tile systems can be classified by three general types--a system of parallel lines, a random system, and an

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[6]Butler, op. cit., pp. 8-9.

intercepting system."[7] The first system as described by Beauchamp is:

> THE PARALLEL LINES systems are used on poorly drained soils having little slope and approximately uniform texture. Variations are the gridiron and parallel systems, the herringbone system, the double main system, and the grouping system.
>
> In the gridiron and parallel systems, one main or submain serves as many laterals as possible. Thus the length and number of outlets are kept to a minimum. The laterals enter the main or submain from one side only. That is the most economical arrangement as the land on only one side of the submain or main is double drained - that is, a narrow strip of land along the main is drained by both the submain and the lateral. The system can be used on land that is uniformly wet if it slopes generally toward the main or submain.
>
> The herringbone system is applicable in places where the main or submain lies in a narrow depression and the laterals must enter from both sides. It is less economical, because considerable double drainage occurs where the laterals and mains join. If the depression over the submain is unusually wet, however, this system will provide better drainage at that point.
>
> The double main system is a modification of the gridiron system. It may be used where the submain is in a broad, flat depression, which frequently is a natural watercourse and sometimes may be wet because of small amounts of seepage water from nearby slopes. A submain on each side of the depression serves the double purpose of intercepting seepage water and providing submains for the lateral. The double main arrangement also eliminates the need to have any laterals cross under the waterways and thus eliminates the possibility that the lateral will be washed out should the waterway deepen by erosion. A submain on each side of the depression also permits a more uniform lateral grade line without an abrupt break in grade. A submain laid at the foot of each slope makes possible more uniform grades for the laterals, and smaller tiles can be used than would be needed for a single main in the center of the watercourse.
>
> Grouping systems, a combination of individual systems, are useful when topography and wetness on the field vary

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[7]The United States Department of Agriculture, loc. cit.

and the pattern of drainage must be changed to fit the different conditions.[8]

The other two systems as described by Beauchamp are:

> THE RANDOM SYSTEM is used in rolling areas that have scattered wet areas somewhat isolated from each other. Tile lines are laid more or less at random to drain the wet places. In most instances, it is better to locate the main so as to follow natural drainageways rather than to make deep cuts through ridges to make straight tile lines. Submains and laterals should be extended from the main to the individual wet areas. If the wet spots are large, the arrangement of the submain and laterals for each wet place may utilize one or more of the parallel systems to provide the required drainage.
>
> THE INTERCEPTING SYSTEM involves the interception of seepage water that follows the upper surface of an impervious subsoil. It is possible to locate tile so that the seepage water will be intercepted and the wet condition relieved. Proper location of the tile for interception of seepage water is important. The seepage plain must first be located by soil borings or by trenching. The tile line should then be placed approximately at the impervious layer along which the seepage water travels. The tile line should also be located so that there are at least 2 feet of cover over the top of the tile.[9]

There seems little doubt but what one of the parallel lines systems would be the most practical and thorough for most athletic and activity fields. It is still valuable, however, to remain aware of the advantages and uses of the other systems since many field areas are so diversified in topography and soil structure that they could very well

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[8] Ibid.

[9] Ibid., pp. 508-9.

take advantage of certain factors offered by the other systems. The most important factor is still that provision must be made for adequate drainage.

II. ACTIVITY AREA LIGHTING

Although lighting for night play may not always be considered a universal need for the junior high school athletic field, the author feels that it is necessary to be prepared for the eventual possibility that the need will arise. The lighting suggestions presented here are limited to the junior high level and include only the activity areas of football, baseball, and the court games. It should be kept in mind that all lamps discussed are of a 1500 watt size.

Football lighting. Lighting a football field requires the use of ten light poles. If a general purpose enclosed lamp is used, it should have a beam spread of from seventy to one hundred degrees. This would require eight lamps on each pole or a total of eighty lamps. If an open type porcelain enameled lamp with or without auxiliary reflector insert is used, the lamp would need a slightly greater beam spread. Depending on whether or not the reflector was used, up to twice as many additional lamps would be needed for the latter type.

Baseball lighting. For lighting a baseball field it is best to use an open type porcelain enameled lamp, with or without auxiliary reflector insert. Using the insert will provide better light coverage. The lamps should have a beam spread of seventy to one hundred degrees. A total of two hundred twenty lamps should be mounted on eight poles. Two poles should be along each sideline and four of them should be spaced in the outfield. The lamps should be mounted at a minimum height of seventy feet.

Lighting for the court games. The recommendations listed here are calculated for a double tennis court. On the court plan presented in Chapter III this is also the equivalent of one basketball court. Eight poles are needed to properly light a court of this size. The same type lamp should be used as was recommended for baseball, except that the beam spread in this case need only cover twenty-nine to forty-six degrees. The four outside poles need have only one lamp each on them. They should be located at the corners of an area one hundred twenty feet long and ninety-six feet wide. The four inside poles should be spaced, two on each side, equally along the one hundred twenty foot length and on a line with the outside poles. These inside poles should carry three lamps each and should direct their light particularly toward the service areas of the tennis courts.

All of the above recommendations reflect the standards of the National Electrical Manufactures Association.[10]

Since there are many factors involved in each individual situation which will affect the light intensity, distribution, and location which is desired, it is best to consult an illumination engineer before any final plans or action are taken. However, it is still valuable to consider the following factors when selecting lighting equipment: (1) desired intensity of illumination; (2) quality of illumination; (3) efficiency of system; (4) cost and convenience of maintenance; (5) cost of installation; (6) appearance of installation.[11]

III. FENCING

A properly organized playground or athletic field may minimize the need for fences, but there are certain areas where the need remains regardless of organization. Fences are desirable around the court areas, ball fields, and special areas where balls may be prevented from leaving. They are also effective as a means to maintain privacy.

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[10]National Electrical Manufactures Association, NEMA Standard Floodlight Layouts for Floodlighting Sports Areas (New York: National Electrical Manufactures Association), pp. 4-16.

[11]Athletic Institute, op. cit., p. 30.

Probably the most important need for fencing is that it provides a safety factor that no school can afford to ignore.[12] Fencing the playground deters the children from running heedlessly into the street and helps prevent injury to the passersby. If the fence is of the proper height it can protect the playground from vandalism. These boundary line fences should be set at least ten feet inside the property or sidewalk line to provide for a planting area outside the fence. This area will serve as a buffer against noise and will aid in creating a park-like atmosphere.[13]

In choosing fencing, certain characteristics should be kept in mind. The good fence should possess stability, durability, economy of maintenance, attractiveness and effectiveness. Chain link fabric made of copper-bearing steel wire, galvanized after weaving, is believed to be the most satisfactory fencing and is most widely used. The thickness of the wire from which these fences are constructed is usually a number six, nine, or eleven gauge. The last named(eleven gauge) is the most commonly used and apparently the most satisfactory. A two inch mesh is recommended.

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[12]Winifred Van Hagen, Genevie Dexter, and Jesse Fering Williams, Physical Education in the Elementary School (Sacramento: California State Department of Education, 1951), p. 78.

[13]Athletic Institute, op. cit., p. 29.

Fence height will vary with the situation in which they are being used. Boundary fences are usually six or seven feet high and court games such as tennis require a fence twelve feet high.[14]

Backstops are, in a sense, fencing, and should be provided whenever doing so will contribute to spectator safety or will add zest and efficiency to the playing of the game. There are many possible types of backstops, but the situation would have to dictate exactly which should be used. However, it is recommended that whenever possible, portable backstops of the batting cage type should be used. The portable backstop makes multiple activity use of the fields more readily possible.[15]

IV. ACTIVITY AREA LANDSCAPING

By going into landscaping, this study presents those factors that will be of use to the total design. This study will limit itself to suggestions about the selection, placement, and planting of shrubs, flowers, and other growth.

Engelhardt, speaking in terms of landscaping, suggests that: "Lawns, shrubbery, flowers, and a variety of

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[14]Butler, op. cit., pp. 13-4.

[15]Athletic Institute, op. cit., p. 30.

trees should be molded into a dignified and harmonious plan."[16] This suggests that a playfield should be more than just a bare field with fences and lines.

Butler suggests that the keynote in planting design should be simplicity. He recommends further that such things about plants as the time element of change and bloom, color, texture, form, and size must be considered. Native nursery-grown plants are the most desirable and should be planted in groups rather than as spotty individual specimens. Turf, which will be discussed in the following chapter, should be considered a part of the planting design. A strip of turf is often just what is needed to set off a group of shrubs or plants. It is important that a total landscape plan be set up at the time the entire field is being planned. In order to maintain the plants once they are planted, it is desirable to enlist the cooperation of the people in the neighborhood as well as the children using the field, to protect them from misuse.[17]

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[16]N. L. Engelhardt and N. L. Engelhardt, Jr., Planning the Community School (San Francisco: The American Book Company, 1940), p. 122.

[17]Butler, op. cit., pp. 142-9.

CHAPTER V

CONSTRUCTION FEATURES OF INDIVIDUAL AREA COVERINGS

The various activities discussed and the area plans which were designed and discussed in earlier chapters require a variety of ground coverings. No all-inclusive advice for all types of surfaces is attempted here. Instead, suggested features of turf, concrete, and bituminous surfaces are presented, as well as a section on construction of a built-up cinder surface for track.

I. TURF

There are a certain number of things toward which one should strive to attain the ideal field covering. Uniformly thick grass, a deep extensive root system, a firm but cushioning surface, an effective drainage system, and a logically conceived and well constructed area as a whole are prime examples. It is the object of this section to provide some of the answers to be used in attaining these goals. Since a very large portion of the field area under discussion is to be covered with turf, and since there is more room for discussion and greater difference of opinion in the area of grass than with any other surface, correspondingly more time is spent on turf in this study than the other area coverings.

Type of Grass to Use

In the matter of what type of grass to use, one can find as many different suggestions as resources. However, it becomes apparent that there are many areas in which authorities consistently agree. Taking this information and combining it with what is definitely known about each type of grass, it is not difficult to come up with a mixture that should develop into a first-class turf.

Everyone uses a certain amount of bluegrass, usually ranging upward from thirty per cent of the total mixture. Bluegrass, when healthy, is a brilliant green color and is very attractive. By far the best of these is the Merion B-27 bluegrass. A comparatively new breed of grass, it has proven to be disease resistant, fast healing, and will thrive even under close cutting.[1]

Another of the new grasses that has resulted from research, and which can be used to advantage, is known as "Penn State Fescue," because it was developed in the laboratories at Pennsylvania State College.[2] This appears to be the best of the fescues, and since that type of grass is always recommended as one of the seed components for any large turf area, it would definitely have to be

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[1]Fred V. Grau, "Better Grasses for Better Turf," Scientific Monthly, 73:262-5, October, 1951.

[2]Ibid.

considered for any durable field.

From here on it seems to be a matter of choice as to whether one desires to use a zoysia, redtop, rye, or bent grass, or one of the many other available breeds, to complete the mixture.

It should prove to be of value here to state what mixtures are recommended by three selected references in this country. Phil Amundson, the chief grounds keeper at Yankee Stadium in New York, relates his preference to be a mixture of Kentucky bluegrass, colonial bent, redtop, and perennial rye grasses.[3] The seeds used at Iowa State College by Superintendent of Grounds Beryl Taylor includes a mixture of bluegrass, alta fescue, and zoysia japonica.[4] In the magazine Better Homes and Gardens, Dale Somers states that the mixture which tests have shown to survive a wider range of conditions throughout the country than any other, consists of the following: ten per cent highland bent, sixty per cent Penn State Fescue, and thirty per cent Merion bluegrass.[5]

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[3]Phil Amundson, "The Most Abused Grass in the World," Better Homes and Gardens, 29:62-3, June, 1951.

[4]Beryl S. Taylor, "Turf That Can Take It," Athletic Journal, 33:22, September, 1952.

[5]Dale Somers, "How to Have a Better Lawn," Better Homes and Gardens, 31:64-5, March, 1953.

The author realizes that these mixtures have been developed over a period of time and are the result of a great deal of experience, but the mere fact that they differ indicates that no one formula need be considered perfect. As a result of this study, the author would recommend a mixture composed of fifty per cent Penn State Fescue, forty per cent Merion bluegrass, and ten per cent zoysia japonica. The latter is especially resistant to disease and insects.[6] These three grasses should be able to stand up under a maximum of rugged use, as well as any reasonable attacks of disease and insects. All these are permanent grasses and will require about a full year to become firmly established. In a situation where this much time is not available, it would be advisable to mix in a portion of fast taking perennial rye grass or possibly some white dutch clover. Both of the last two mentioned grasses would die out after the first year but in the meantime would provide a protective cover for the permanent grasses. It is wise to buy the seeds separately and mix them yourself as this is a more nearly certain way of being sure that you are getting the seeds you want. Although the initial cost of the best grasses is high, they are

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[6]"Building a Hardy Lawn," Life, 33:70-8, September 8, 1952.

easily worth it because of their superior growth and comparatively inexpensive maintenance.

Preparation for Planting

Probably the initial concern in the preparation of the activity field is that of a good drainage system. The different types of drainage systems have already been discussed. According to Beryl S. Taylor of Iowa State College, tile drainage systems do not cost too much to put in, and one can forget about them for years after they have been installed.[7]

Soil condition. Any soil that will provide a good turf base is sufficient for this purpose. A sandy-loam topsoil to a depth of at least four to six inches is highly desirable. In preparing the seed bed, Dr. Mortensen of the Washington State College Experiment Station suggests a liberal application of phosphate and potash, followed by a small application of nitrogen.[8] He says further, however, that to be sure of the soil needs, a sample of the soil should be taken to the county or state agricultural extension service office for testing. In most cases,

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[7]Personal letter from Beryl S. Taylor, Iowa State College, Ames, Iowa, to Darrell W. Johnson, February 11, 1955.

[8]Opinion expressed by Dr. Walter P. Mortensen, Washington State College Experiment Station, personal interview, January 3, 1956.

some fertilizer will need to be mixed into the soil. The soil test will also reveal any need for treatment of the PH level (whether it is acid or alkaline) of the soil. The PH should be about 6.5 to 7.0, or almost neutral.[9]

During the period of preparation, the field should be constantly watered, rolled lightly, and worked over to fill depressions. This will assure a smooth, even field, if continued until the ground remains completely smooth after a severe watering. Be particularly careful to avoid leaving any trees, logs, et cetera, underground in a field, since when they rot, depressions will be left on the surface.

Planting and Immediate Care of Turf

The time of planting seems to be largely dependent upon local conditions and the individual situation. Many authorities claim that seeding should be done in the fall of the year. However, local experts, including Dr. L. G. Nelson of the Washington State College Experiment Station, indicate that planting should take place in the spring or summer months, and seldom later than August.[10] In preparing the seed bed, once it is completely leveled by the

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[9]"Building a Hardy Lawn," op. cit., p. 73.

[10]Opinion expressed by Dr. L. G. Nelson, Washington State College Experiment Station, personal interview, January 3, 1956.

method described earlier, rake off all the stones. Then wait for a few weeks for any weeds in the soil to grow. A second raking should pull these weeds. For the actual application of the grass seed, it is recommended that some type of standard seed spreader be used. If the seeds are mixed, seeding should be done both directions and at a ninety degree angle from one another. If the seeds are sown separately, one type may be planted while running the seeder in each direction.

In figuring the amount of seed to be used for a given area, the manufacturers' recommendations should be followed. To make this as easy as possible, it is suggested that the field be laid out in areas of about a thousand square feet, and the seed used according to recommendations. The surface of the ground should be dampened lightly before the seeding process takes place. If the seeds are covered, it should be done very lightly, since some types of seeds require light to germinate.[11]

Early care should include watering with a fine spray and doing so often enough so that the ground will not dry out. By all means, no one should walk on the seed bed.

When the grass reaches the height of two inches, it should, according to one source, be mowed down to a

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[11]"Building a Hardy Lawn," op. cit., pp. 76-8.

height of one and one-half inches. This program would continue until winter, all the time leaving the cut grass on the field. A more flexible program of mowing, as proposed by Mortensen, is to clip the grass as high as possible during the first year and as the growing season progresses, to gradually bring the cutting level down to the required height in time for the field's first use.[12]

Watering the Turf

Regardless of the climate, some provision must be made for artificial watering of the athletic field areas. As unnecessary as this suggestion seems, the caution is well founded. The author is acquainted with one junior high school situation where a fairly large activity field was prepared and planted at the cost of several thousand dollars, but because of insufficient provision for watering the field suffered badly in a recent hot spell.

The prime object of watering grass is, of course, to provide it with the necessary moisture to sustain life. However, how the water is applied can mean the difference whether or not the grass roots are shallow or deep. This factor, in turn, often regulates the health and the very life of a stand of turf. Watering should be done infrequently.

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[12]Mortensen, loc. cit.

Once a turf has been established properly, watering need not be done except when a trowel dug four inches into the turf shows dryness that deep. The watering should be done during the time of the day that it does not get direct sunlight and should be soaked deep into the soil so that the roots will grow down and use the moisture from the cool moist layers of the earth.[13] This could require letting the sprinklers run from eight to ten hours. It can be done at night with the least possible interference to any program that would be using the field.

The type of water sprinkler used is generally dependent upon the individual situation. The sprinkler should produce a slow, steady spray and must water uniformly.

How much water to apply depends on the water retention characteristics of the soil and on the extent to which the grass roots have taken the water from the soil.[14] Clay or loam soil will retain water much longer than a sandy soil. Amount of water application will thus have to be determined for each individual field. The foregoing points should all be taken into account when deciding what type of sprinkler system to use.

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[13]Beryl S. Taylor, "Turf That Can Take It," Athletic Journal, 33:22, September, 1952.

[14]The United States Department of Agriculture, Water The Yearbook of Agriculture 1955 (Washington, D.C.: The United States Government Printing Office, 1955), p. 462.

II. CEMENT CONCRETE

The surfacing material cement concrete is most commonly called concrete. In it, hard aggregates of varying sizes are bound together by minute particles of cement which form adhesive qualities when mixed with water. This type of surface is desirable when a permanent, hard, durable surface is required. Even though it is desirable under certain circumstances, concrete is not the best surface for general playground and activity use. However, it has been used to a reasonably large degree for such special activities as tennis, handball, and other such court games where a uniform rebound of a ball is of maximum importance. Although the initial cost of a concrete surface is comparatively high, its long life expectancy (about thirty years) and minimum need for maintenance at least partially makes up for the cost. However, it is generally indicated that the material has very little advantage over bituminous type surfaces. This is especially true in view of comparative costs.[15]

III. BITUMINOUS SURFACES

Bituminous surfaces generally include a wide range

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[15] Playground Surfacing, A report of the Research Committee on Playground Surfacing of the National Association of Public School Business Officials (Pittsburgh: National Association of Public School Business Officials, 1940), p. 4.

of materials in which coarse and fine aggregates are solidified by bitumens. By changing the aggregates or modifying methods of construction, it is possible to provide a reasonably resilient or an extremely hard surface. If the hard non-resilient surface is desired, gradations of limestone, slag, or granite can be mixed with a heavy bodied, high point bitumen. For a resilient effect, such materials as cork, wood pulp, asbestos, rubber, or similar material can be applied to the top surfacing of the bituminous base.[16] This resilient material can be of particular use for the safety of players in such areas as around the basketball backboards.

There seems little doubt as to the effectiveness and practicality of this type of surface. Jones relates that:

> An analysis of facts gathered to date by the surfacing committees of the American Institute of Park Executives and the National Recreation Association, indicate that asphaltic bituminous surface should be retained as the standard for the general play area.[17]

Rubber-bituminous Combination

Several commercial organizations have taken steps

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[16]Athletic Institute, A Guide for Planning Facilities for Athletics, Recreation, Physical and Health Education (Chicago: The Athletic Institute, Inc., 1947), p. 28.

[17]T. H. Jones, "Specifications for Asphaltic Pavement on a Playground," Recreation, 47:112, February, 1954.

to produce surface materials which will provide resiliency to a bituminous base. One of these is the Xylos Rubber Company, a division of the Firestone Tire and Rubber Company, which produces what they call "Rub-R-Play Material." It is a ground rubber material which is applied to the surface of the bitumen. It has been tried extensively in the school grounds of Akron, Ohio, and apparently has been very successful. It would seem that the prime problem with this surface is its cost. Harold Carlson of the Xylos Rubber Company personally reported to the writer that:

> The cost of applying this Rub-R-Play surfacing to a playground of approximately 1500 square yards in area, is approximately $1.70 per square yard for three applications of rubber, including all labor and materials, but not including the cost of the base.[18]

The writer believes that for schools such a cost would make Rub-R-Play prohibitive for any installation of much size. However, it would still be financially feasible to use the rubber coating in certain specialized areas such as under horizontal bars, swings, and other apparatus. In view of the decreasing cost of other surfacing materials after they have been on the market for a period of time, it seems likely that the future will see a lower cost level for these special surfaces.

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[18]Personal letter from Harold V. Carlson, Xylos Rubber Company, Akron, Ohio, to Darrell W. Johnson, May 27, 1955.

IV. THE BUILT-UP CINDER TRACK

Any well constructed running track is put down in three layers. The first layer is of coarse rubble, stone, or clinkers, the middle layer of medium clinkers, and the top dressing of some mixture of fine cinders and clay. There is much disagreement about the exact materials and their proportions that should be used to obtain the ideal track. There is, in fact, disagreement as to whether the track should be resilient or hard, although some spring in the surface is generally preferred. Some tracks are constructed in elaborate fashion with a variety of local materials. For example, the new University of Southern California track uses such things as decomposed granite, washed pea gravel, ground redwood bark, and sand as well as the standard crushed rock, cinders, and clay. The track was laid in six layers.[19] Doherty did some extensive research on track construction throughout the country and, as a result, was able to report some interesting and useful information. The first move in laying the track is to excavate from twenty-one to twenty-four inches. This is always necessary in areas where much rain is likely. If rain is even a moderately severe problem, drain tile should

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[19]Jess Mortensen, "The New U.S.C. Track," Athletic Journal, 33:8, January, 1953.

be used. The tile could run either laterally to the track or with it.[20]

The rough fill or first layer should be of either heavy clinkers or three to four inch stone, either crushed or in the form of gravel. About twenty inches of this layer is usually adequate. If no drain tile is used, this layer should be rolled. If tile is used, rolling would likely injure it.

For the middle layer, on top of the rough fill, about six inches of coarse cinders such as would be retained on a three-quarter inch mesh screen should be used.

For the top dressing, the usual opinion among track coaches throughout the country suggests that three parts of front cinders to one part of clay is the best proportion. "Front" or "head-end" cinders are the hard little cinder pellets that are caught by the locomotive stack screen and dropped back into the head-end of the fire box to be shoveled out at the roundhouse. Unfortunately, most boiler cinders crush easily and either turn to dust or mud, depending on the weather. Since front cinders are difficult to obtain, care must be taken in the use of substitutes.[21]

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[20]J. Kenneth Doherty, Modern Track and Field (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1953), pp. 415-7.

[21]Ibid.

The track curb should be four inches wide and should rise four inches above the track. The total depth should be about eighteen inches. However, final determination of depth should be based on the frost line and should be established so that no heaving can take place during the winter months.[22]

Research in the three basic area coverings indicates that, because of the rapid technical advances being made, construction should take advantage of the latest information available.

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[22] Ibid.

CHAPTER VI

SUMMARY AND CONCLUSIONS

In this study an attempt has been made to search out and record that information which the lay-schoolman would need to know in order that he might participate actively in the planning for construction of an outdoor athletic and activity area for a modern junior high school. The study was started by a determination of what activities should be taken into consideration in such a plan. This was followed by considerations of design, including examples of field and individual area design. Various diversified problems of construction encountered were discussed in Chapter IV. Chapter V was devoted to a complete discussion of individual area coverings for the athletic and activity areas.

I. SUMMARY

Recommended Junior High School Outdoor Activities and Their Area Needs

The activities which must be accounted for in the planning include volleyball, basketball, tennis, badminton, paddle tennis, deck tennis, handball, horseshoes, quoits, football, soccer, speedball, and field hockey. Also requiring consideration are softball, baseball, calisthenics,

marching, track and field, archery, shuffleboard, and camping education. Because of the broad educational values to be desired from such a structure, it was decided that an amphitheater should also be considered in the ultimate plans.

For the operation of a program of this scope in a junior high with eight hundred to a thousand students, considerable facility development is needed. It would have to include two hard top areas of at least one hundred ten feet by two hundred feet, a standard football field surrounded by a four hundred forty yard track, horseshoe pits, a baseball diamond and field, an amphitheater, a wooded area, parking lots, and enough turfed field area to accommodate six to eight field game areas as well as the same number of softball fields. This must be regarded as the ultimate, but despite the cost involved should still be strived for by all school districts where the weather makes such a project practical.

Considerations of Design

Existing features of the area must be taken into consideration. The condition of the soil, the slope of the land, the presence of any trees, shrubs, or other natural features that could be used in the final plan, are all very important. Such natural conditions as the

prevailing wind direction for the area, general level of rainfall, and temperature range are other factors which will influence design.

In order that full use is made of all facilities, design must be focused on combination or multi-purpose areas. For example, one of the hard topped areas can be used for basketball, tennis, paddle tennis, badminton, and various low organization type games. Another hard topped area could be used for an automobile parking lot for evening activities and spectator sports, as well as for volleyball, circle games, and various other activities. This quick change is made possible by the use of different colored lines on the courts and by capped sleeves in the hard top which can serve as a base for the various net standards. The turfed field areas serve many purposes through the use of mutually sized areas for the field games, sleeves for goal posts, and portable backstops for the baseball type games. The key to organization of combination areas is to group these activities with a need for a mutual type facility.

Most individual area designs are easily obtained from a variety of sources. Some of the designs that contain different design, idea, or point of view are presented here, as well as some generally accepted designs that are considered by the author to be especially helpful.

The designs include a combination track and field lay-out, a baseball diamond showing skinned areas, line designs for two hard surface court areas, and a radical design for use in a limited area that combines the three major activities of football, baseball, and track into a single area. In addition, the writer presented his own idea of a possible total area design which combines most of the ideas of individual design discussed up to that point.

Specific Problems for Construction Consideration

Drainage, lighting, fencing, and landscaping were presented as problems necessitating special consideration.

Drainage of any specific area may be divided into two types, "surface drainage" and "sub-soil drainage." Surface drainage is controlled by the grade of the ground. Sub-soil drainage refers to any system which drains the water through the surface and away. This could be by means of proper soil construction, but more often the term refers to the use of drain tile. Tile systems were discussed under three general types: (a) a system of parallel lines; (b) a random system; and (c) an intercepting system. As their names indicate, the systems differ mainly in the placement pattern of the tile.

With the ever increasing use of artificial lighting for night athletic contests and activities, it behooves

the planner to thoroughly consider available material on it. Certain general specifications for lighting can be made, but it is wise to consult an illumination engineer before any final action is taken. However, the person who would use the facility should consider certain factors when selecting lighting equipment such as: (a) desired intensity of illumination; (b) quality of illumination; (c) efficiency of the system; (d) cost and convenience of maintenance; (e) cost of installation; and (f) appearance of installation.

Fencing is a necessity in any athletic area, for the protection of the participant and the spectator, as well as to make the activity more enjoyable and efficient. The good fence should be durable, stable, economical to maintain, attractive, and effective. An eleven gauge chain link type fence with a two inch mesh is recommended. Fence height will vary with the situation.

The properly planned field should be landscaped by the effective use of plants, shrubs, trees, and turf. Each should be selected carefully and planted as a part of a total plan rather than as spotty individual groups.

Construction Features of Individual Area Coverings

The majority of the surface of any properly conceived activity area should be turf. Some new and excellent grasses for the turf field include Penn State Fescue, Merion

bluegrass, and zoysia japonica. These three used in the proper combination and given the proper care during their development should produce the most durable and handsome turf available today. A sandy-loam soil is the most desirable for planting a good turf. Most soils need fertilization, but rather than guess at specific needs, it is wise to consult the county or state agricultural extension service office for a soil test. Proper care in soil preparation, seeding procedure, and immediate care of the turf will save much time and expense for later maintenance. Provision for a complete and efficient watering system must be made if the turf is to survive after it has been planted. The type of sprinkler that should be used is generally dependent upon the individual situation.

Concrete surfaces can be desirable for some special games such as tennis and handball, but the high cost and unyielding surface make it impractical for extensive playground use.

Bituminous surfaces seem to be the answer to hard surface needs. Depending on the mixture used and the methods of application, the bituminous surface can be made hard or resilient. For the resilient effect, such materials as cork, wood pulp, asbestos, rubber, or similar materials can be applied to the top surfacing. The most widely promoted of these, on a commercial basis, is the rubber-bituminous combination.

A running track should be constructed in three layers. After excavation, about a twenty inch bottom layer of heavy clinkers or three to four inch stone is applied. This is topped by a six inch middle layer of coarse cinders. The top dressing should be composed of three parts of front cinders mixed with one part of clay. In most areas it is necessary to build in an underlying tile drainage system. A concrete track curb four inches wide and eighteen inches deep should rise four inches above the track level.

II. FURTHER RESEARCH NEEDS INDICATED BY THE STUDY

As a result of this study a number of specific subjects have come to be recognized by the author as needing some closely defined and intensive research.

Bituminous Surface Combinations

Although suggestions for materials which can be combined with bitumen to produce a resilient effect are plentiful, it appears that there is very little experimental evidence upon which to base a decision as to their comparative merits. As a result, it is suggested that a study could be made where as many bituminous surface mixtures as possible were constructed and subjected to a

controlled experiment in use. The results would show comparative cost, durability, resilience, and other desirable features.

Track Top Dressing

There is a need for the discovery of certain local products which might replace the scarce "front cinders" referred to in Chapter V, but which would still provide comparative quality to the mixture.

Outdoor Education Design

Although outdoor education design was clearly not within the realm of this study, the author sees a need for specific work on a design for such an area. This design should be complete to the detail of showing every projected need of a maximum outdoor education program, including names of plants, possible planting patterns, camping facilities, and any other features suggested by the school's camping program.

III. CONCLUSIONS

This study was begun with the idea of providing the author with information that would enable him to actively and intelligently participate in the planning of junior high school outdoor athletic and activity facilities. It has done more than that. This study has opened up a broad

new horizon of potentially enlightening specific areas of research which are of vital importance to field construction today. The information presented can provide help in planning for an outdoor athletic and physical education activity area. It is hoped that future intensive study in the areas discussed will lead to more intelligent participation in planning by physical education directors and teachers.

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